ME-120

OPERATION
AND
SERVICE MANUAL

INDUSTRIES, INC.

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PARTS LIST
SCHEMATICS
MARKERS (Optional)

NASA 94

MODEL HD-1A

T.O.S. No. 105
Serial No.
SWEEP GENERATOR

Telonic INDUSTRIES, INC. BEECH GROVE, INDIANA

054
5/66

WARRANTY

TELONIC INSTRUMENTS AND ACCESSORIES

Products manufactured by TELONIC INDUSTRIES, INC. are guaranteed against defective materials and workmanship for a period of one year (vacuum tubes excepted) from date of purchase. This warranty does not apply to instruments that have been altered, improperly handled or damaged in any way beyond our control.

Instruments must be examined immediately upon receipt, since claims for damage in transit will not be honored by the carrier unless prompt action is taken.

CHANGES IN SPECIFICATIONS

The right is reserved to change the published specifications of equipment at any time, and to furnish merchandise in accordance with current specifications, without incurring any liability to modify equipment previously sold.

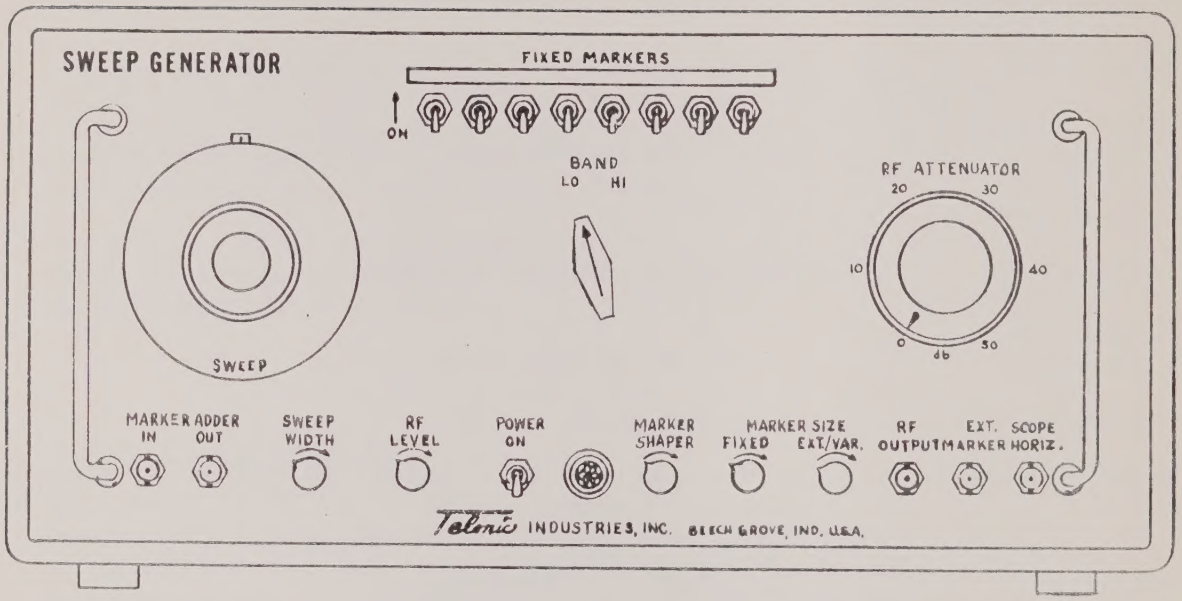
RETURNING EQUIPMENT TO FACTORY

Factory service is available for repair and readjustment of this instrument. However, a description of the trouble, plus the MODEL AND SERIAL NUMBERS of the unit should be forwarded FIRST, whereupon instructions for correcting the trouble OR authorization for returning the equipment will be given. This applies to all units, whether under warranty or not.

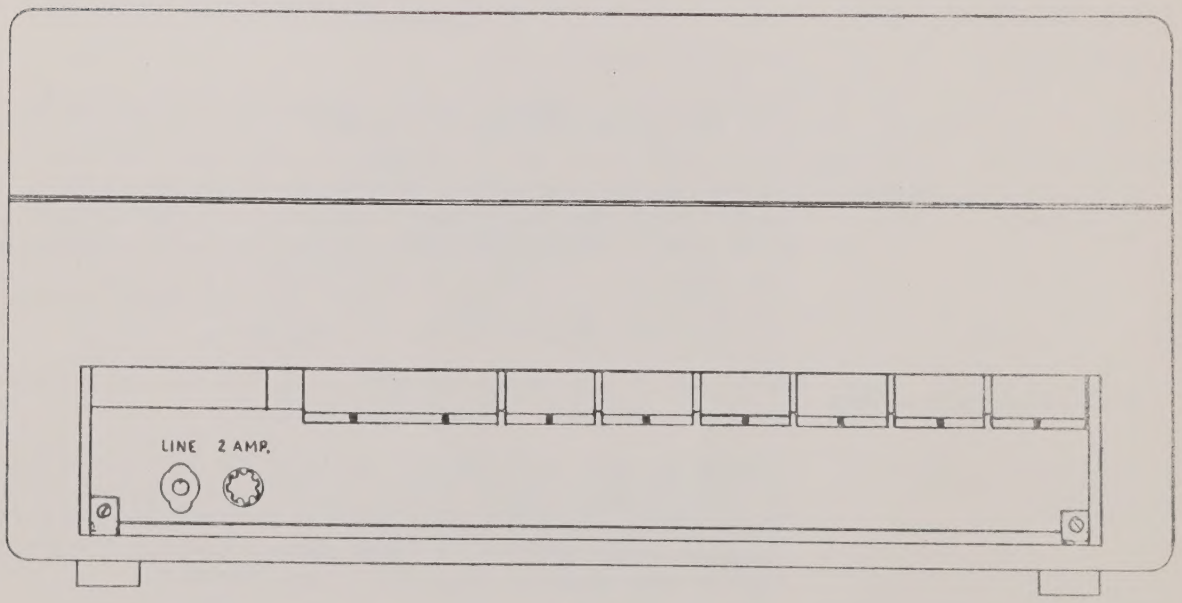
SPECIFICATIONS

MODEL HD-1A SWEEP GENERATOR

CENTER FREQUENCY	LOW BAND 0.5-400 MC	HIGH BAND 390-900 MC
FREQUENCY RANGE	0.5-400 MC	360-910 MC
SWEEP WIDTH	200 KC-200 MC	0.03-10%
OUTPUT		
Voltage	0.75 volts peak to peak	2 volts peak to peak
Impedance	50 ohms	
Flatness	±5% over maximum sweep width	
ATTENUATION		
Turret	0, 10, 20, 30, 40, 50 db.	
Vernier	0 to over 10 db.	
DISPLAY LINEARITY	Normally below 1.2:1. Set at the factory for below 1.2:1 at a center frequency of 300 Mc and 200 Mc sweep width with 50 Mc harmonic markers.	
RADIATION	Less than 10 microvolts	
SWEEP RATE	Line Frequency (50-60 c.p.s.). Specifications are verified at 60 c.p.s.	
ZERO BASE LINE	Oscillator off during sweep retrace	
SCOPE HORIZONTAL SWEEP	Approximately 15 volts peak-to-peak	
SOURCE VSWR	Normally below 1.2:1	
POWER	115/230v a.c., 50/60 c.p.s., approximately 120 watts	
MARKER SYSTEM		
Birdy-By-Pass Marker Circuitry	The output of the marker oscillators is mixed with a signal from the sweep oscillator to produce beatnotes or birdies. These are amplified and superimposed upon the detected r-f output signal before it is applied to the vertical scope input. Amplitude and shape of the markers are adjustable over a wide range.	
External Marker Input	An external c-w signal of approximately 0.1 volts may be used to produce a "birdy" type marker.	
Plug-In Crystal Markers	Provisions are included for up to eight single frequency or four harmonic type plug-in crystal-controlled markers. These markers are optional and may be included in this instrument or added at a later date. See our literature for further details regarding these markers.	
PHYSICAL DESCRIPTION	Panel Size - 1/8" x 8 3/4" x 19" Chassis Size - 2" x 14 1/2" x 17"	


SWEEP GENERATOR
FIXED MARKERS
ON
BAND
LO HI
RF ATTENUATOR
20
30
10
40
0
db
50
SWEEP
MARKER IN
ADDER OUT
SWEEP WIDTH
RF LEVEL
POWER ON
MARKER SHAPER
MARKER SIZE
FIXED
EXT/VAR.
RF OUTPUT
EXT. MARKER
SCOPE HORIZ.
Telonic INDUSTRIES, INC. BEECH GROVE, IND. U.S.A.

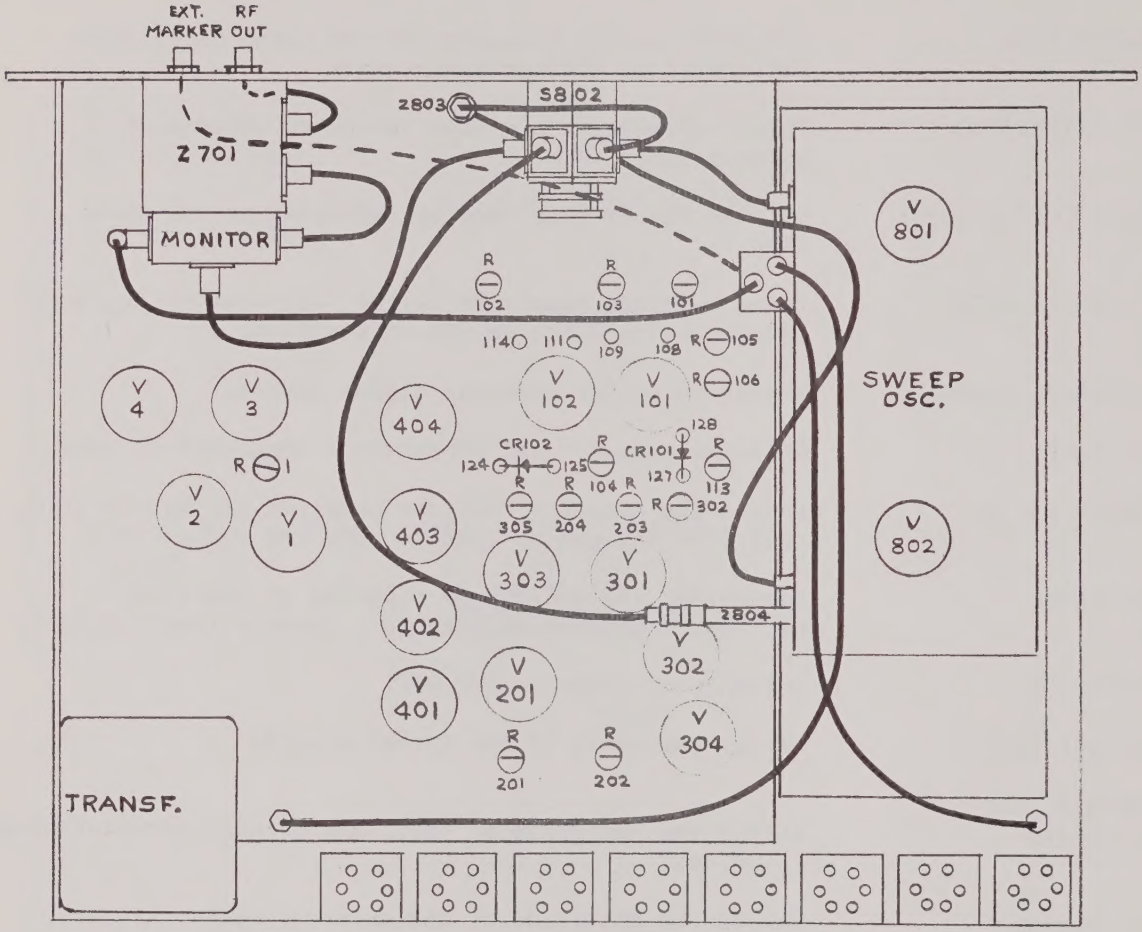
FRONT


LINE 2 AMP.

REAR

DESCRIPTION OF FRONT PANEL

SWEEP DIAL	Indicates center frequency of the sweep oscillator. Calibrated at minimum sweep width.
RF ATTENUATOR	Turret Attenuator provides indicated amounts of attenuation.
BAND SWITCH LO-HI	Selects low or high band as indicated on the sweep dial.
FIXED MARKERS	These switches supply B+ to the fixed markers (crystal plug-in units) when in the on position.
EXTERNAL MARKER	Marker input for external signal source.
RF OUTPUT	RF sweep output - BNC Connector - Impedance 50 ohms.
SWEEP WIDTH	Varies the amount of voltage supplied to the vibrating capacitor and can be used to vary the sweep width.
RF LEVEL	Determines the average B+ supplied to the sweep oscillator and may be used as a vernier level control.
POWER ON	Switches AC power on and off.
MARKER SHAPER	Varies the width of the marker signals.
MARKER SIZE	
Fixed	Varies the amplitude of the fixed markers (crystal plug-in units).
Ext/Var	Varies the amplitude of the external marker signals.
MARKER ADDER	
In	The demodulated signal from the device being tested is fed into this connector so that marker signals may be superimposed.
Out	This connector should be connected to the vertical input terminals of the scope for viewing the demodulated signal and markers.
SCOPE HORIZONTAL	This connector should be connected to the scope horizontal amplifier input.



V1	5651
V2	6AU6
V3	EL84/6BQ5
V4	EL84/6BQ5
V101	12AX7
V102	12AX7
V201	12AX7
V301	6AU6
V302	12AX7
V303	6AU6
V304	EL84/6BQ5
V401	12AX7
V402	12AX7
V403	12AX7
V404	12AX7
V801	6DZ4
V802	6DZ4

DESCRIPTION OF CHASSIS CONTROLS

R1 - B+ ADJUST — This control varies the bias on the amplifier, (V2), for the B+ regulator, (V3), and is adjusted to produce a regulated B+ voltage (B+2) of 175 volts.

R201 - BLANKING PHASE — This control adjusts the phase of the blanking pulse with reference to the phase of the sweep oscillator.

R202 - BLANKING WIDTH — This control is the grid resistor for the blanking pulse generator (V201). It is adjusted to blank one-half of the sweep cycle to produce a zero base line.

HIGH BAND ADJUSTMENT

R102 - SWEEP WIDTH LIMIT — This potentiometer controls a voltage supplied to the front panel SWEEP WIDTH control and is used to adjust the sweep width when the front control is set at maximum.

R104 - HORIZONTAL SIZE — This control adjusts the size of the horizontal output when the front panel SWEEP WIDTH control is set to its maximum position. It is adjusted to maintain a constant horizontal size at all sweep width settings.

R105 - HORIZONTAL PHASE — This control adjusts the phase of the scope horizontal sweep voltage with reference to the phase of the sweep oscillator.

R113 - LINEARITY — This control can be used to change the waveform of scope horizontal output (V101). It is normally set for best linearity at maximum sweep width.

R303 - LEVEL MINIMUM — This control is used to adjust the output level when the front panel LEVEL control is at its minimum position.

R305 - LEVEL MAXIMUM — This control is used to adjust the output level when the front panel LEVEL control is at its maximum position.

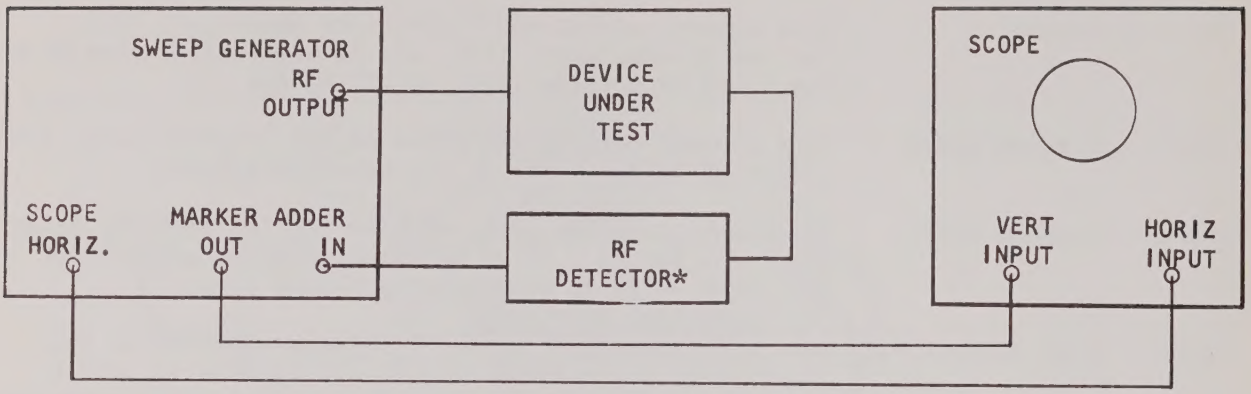
LOW BAND ADJUSTMENT

R101, R103 - SWEEP WIDTH ADJUSTMENT — These two potentiometers limit the voltage supplied to the dual front panel SWEEP WIDTH control and are used to adjust the sweep width when the FRONT PANEL control is set at maximum. R101 controls the sweep width on the low frequency side of the display and R103 the high frequency side.

R106 - HORIZONTAL PHASE — This control adjusts the phase of the scope horizontal sweep voltage with reference to the phase of the sweep oscillator.

R302 - LEVEL MINIMUM — This control is used to adjust the output level when the front panel LEVEL control is at its minimum position.

R304 - LEVEL MAXIMUM — This control is used to adjust the output level when the front panel LEVEL control is at its maximum position.



TYPICAL SET UP - The following procedure is recommended for setting up this instrument in test position.

1. Connect unit to proper power line voltage and turn POWER ON switch to ON position.

2. Make connections to the scope, the device under test, and RF Detector as shown above. All connectors located on the sweep generator are BNC type and it is recommended that RG cable be used for all connections. This insures good ground connection between each device, minimizes hum, leakage from unit and pick up of spurious external signals. The cable that is used to connect the RF OUTPUT to the device under test should match the impedance of the sweep generator. If the input impedance of the device under test is different from the impedance of the sweep generator, a matching network should be used to insure a constant input signal.

3. Adjust the RF output level by means of the RF LEVEL control and the step RF ATTENUATOR to the proper input signal for the device being tested. Failure to do this will result in a misleading scope pattern.

4. Adjust the SWEEP WIDTH control and center frequency SWEEP DIAL to cover the desired frequency range.

5. MARKERS
   Markers may be produced by one or more of the following methods.
   A. Plug-in crystal markers (C type).
   B. Plug-in crystal harmonic markers (CDH or CH type).
   C. External C.W. Signal.
   First turn on marker unit or inject external C.W. signal and adjust MARKER SIZE and SHAPER until markers are of a convenient size and width.

*See Telonic literature for detector recommended for use with this instrument.

INTERNAL CONTROL ADJUSTMENT

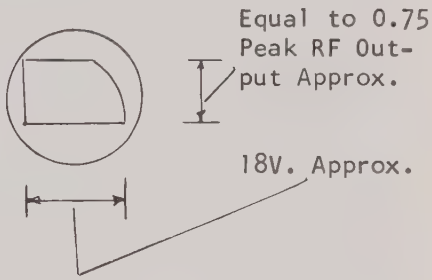
PRINTED WIRING BOARD CONTROLS are adjusted at the factory and normally do not require any readjustment. However, should it be desirable to check adjustments, follow these steps:

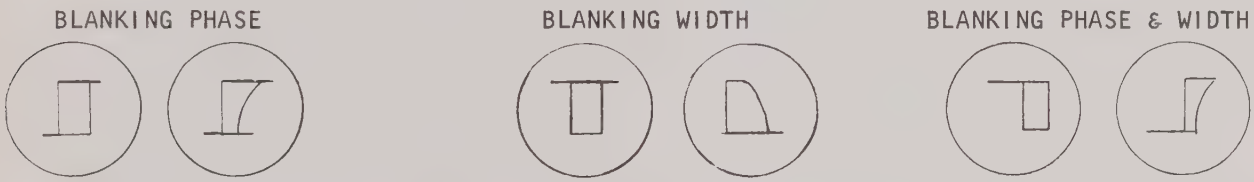
1-Connect unit as shown under operating instructions but omit the device under test. The recommended detector for the unit is the Telonic XD-3A. Turn unit on.

2-B+2 ADJUSTMENT: Adjust R1 to provide a regulated B+ voltage of 175 volts.

THE FOLLOWING ADJUSTMENTS ARE MADE WITH THE BAND SWITCH IN THE HI BAND POSITION

3-BLANKING PHASE and WIDTH ADJUSTMENTS: Set front panel SWEEP WIDTH control to its maximum counter-clockwise position, front panel RF OUTPUT LEVEL control to its maximum clockwise position and the ATTENUATOR to its 0 db. position. The "normal" pattern which should appear on the oscilloscope may be nearly rectangular, may have a rounded upper right corner as shown in the figure to the right, or may be between the two in appearance. If not, adjust BLANKING PHASE and WIDTH controls, R201 and R202. If BLANKING PHASE and WIDTH controls are misadjusted, the pattern seen may be similar to one of those shown below.





4-RF OUTPUT LEVEL MIN and MAX ADJUSTMENTS: With the front panel RF LEVEL control in its maximum clockwise position, adjust LEVEL MAXIMUM control, R305, until vertical height of the pattern equals 3/8 of the peak to peak RF output voltage shown on the specification sheet, Page 1. Since the RF Detector is approximately 75% the actual RF output voltage will be approximately as specified. Turn turret attenuator to 10 db. position and record the height of the pattern. Return the turret attenuator to the 0 db. position. Turn the front panel RF LEVEL control to its maximum counter-clockwise position and adjust LEVEL MINIMUM control, R303, until the height of the pattern is slightly less than it was with 10 db. inserted in the output circuit. This procedure insures that the RF LEVEL control will provide over 10 db. of vernier attenuation.

5-HORIZONTAL PHASE and SIZE adjustments: Return the front panel RF LEVEL control to maximum clockwise position. Set the HI/LO switch to the HI position. Rotate the SWEEP WIDTH vernier fully counter-clockwise. If the pattern is not normal, adjust HORIZONTAL PHASE, R105. Note the amplitude of the horizontal deflection on the oscilloscope. Rotate the SWEEP WIDTH control fully clockwise. Adjust HORIZONTAL SIZE (high band) R104, for the same horizontal deflection as seen at minimum sweep width.

MARKERS MUST BE PROVIDED FOR THE FOLLOWING ADJUSTMENTS

6-SWEEP WIDTH ADJUSTMENT: With the front panel SWEEP WIDTH control in its maximum clockwise position, adjust the SWEEP WIDTH LIMIT, R102, to provide the maximum sweep width as shown on the specification sheet, Page 1.

7-LINEARITY ADJUSTMENT: Linearity may best be adjusted when a number of markers are present on the display. In the factory, a harmonic generator is used for this purpose. The LINEARITY control, R113, is adjusted for equal spacing between the markers. Adjusting the

LINEARITY control will change the size of the scope horizontal signal, therefore, the HORIZONTAL SIZE control must be readjusted; see step 5. The HORIZONTAL PHASE control also has an effect on linearity and can be adjusted slightly to obtain optimum linearity. Generally it is adjusted to spread the markers at the low frequency side of the display as much as possible and still maintain a rectangular pattern. If a harmonic generator is not available, a variable marker may be used. The linearity adjustment is made so that there is an equal frequency difference from the center of the presentation to each side.

THE FOLLOWING ADJUSTMENTS ARE MADE WITH THE BAND SWITCH IN THE LOW BAND POSITION

8-RF OUTPUT LEVEL MIN. and MAX. ADJUSTMENTS: Adjustment procedure is the same as the hi band adjustments outlined in step 4, substituting R304 for R305 (MAX. ADJUSTMENT) and R302 for R303 (MIN. ADJUSTMENT). R304 must not be adjusted for more than rated output since this will cause an unleveled RF output signal.

9-HORIZONTAL PHASE ADJUSTMENT: Set SWEEP WIDTH control to its maximum clockwise position. If pattern is not rectangular, adjust HORIZONTAL PHASE, R106, until a rectangular pattern is obtained.

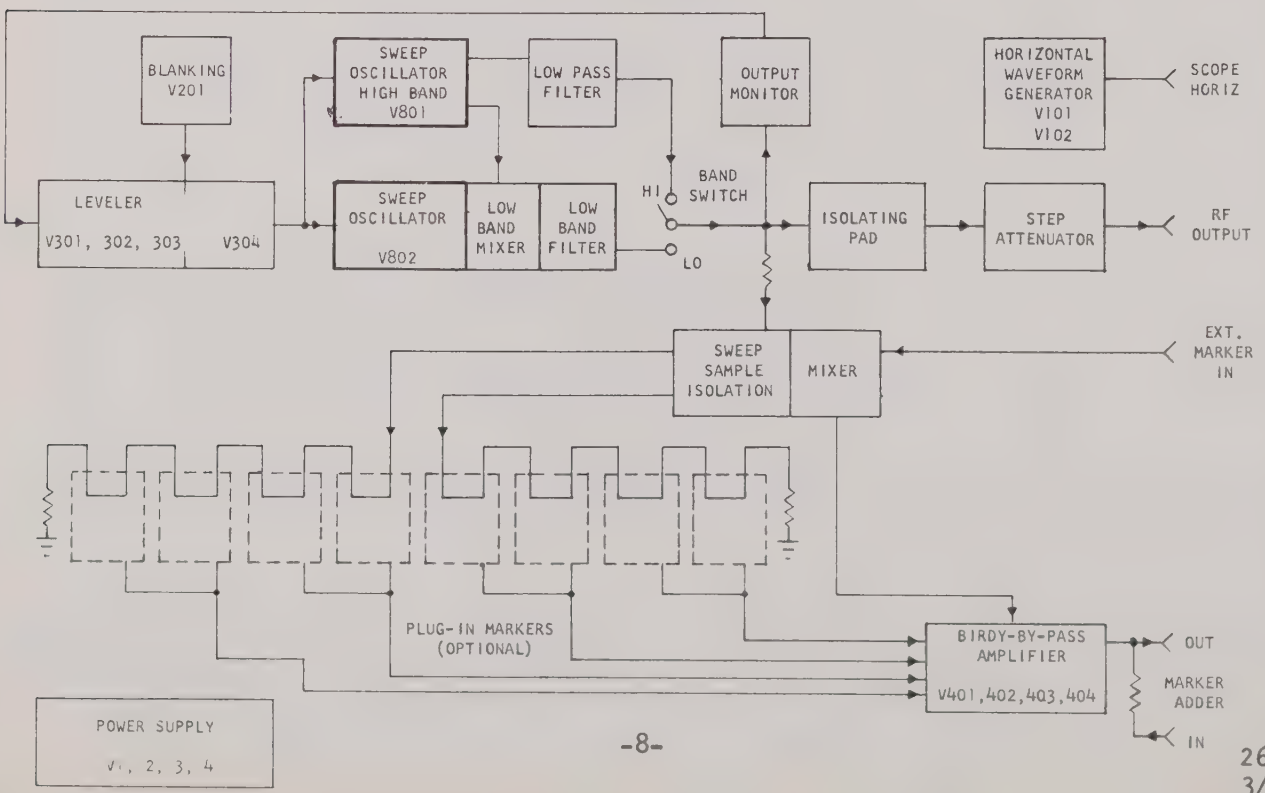
10-HORIZONTAL SIZE ADJUSTMENT: Check for any change in horizontal size between minimum and maximum sweep width as on the high band. If necessary, adjust HORIZONTAL SIZE (low band), R120, at maximum sweep width to give horizontal size the same as at minimum sweep width.

MARKERS MUST BE PROVIDED FOR THE FOLLOWING ADJUSTMENTS

11-SWEEP WIDTH ADJUSTMENT: With the front panel SWEEP WIDTH control set for maximum sweep width and the SWEEP DIAL set for a frequency of 300 Mc, adjust R101 until the lowest frequency obtained on the display is 200 Mc. R103 is next adjusted until the highest frequency obtained on the display is 400 MC.

12-LINEARITY: There are no linearity controls for the low band. Linearity is obtained by the proper adjustment of the SWEEP WIDTH controls, R101 and R103, and by the HORIZONTAL PHASE control, R106.

BLOCK DIAGRAM



SWEEP OSCILLATOR

HI BAND: The sweep oscillator of this unit is a fundamental frequency type, using a 6AF4 tube and tuned line circuitry. A vibrating capacitor, consisting of a silver plated beryllium copper diaphragm is used to obtain the sweep. A low pass filter is included in the output circuitry to minimize harmonics in the R.F. output and to insure optimum performance of the leveling circuitry.

LOW BAND: The low band output is produced by the heterodyne method which combines the output of the Hi Band Sweep Oscillator with a second fixed tuned sweep oscillator. These two sweep oscillators are swept 180° out of phase which accounts for the wide sweep width since the sweep width of each sweep oscillator is added in the heterodyne output. This method of sweeping also produces excellent linearity since the nonlinearities of each sweep oscillator are canceled in the heterodyne output.

Four diodes in a bridge circuit produce the mixing of the two fundamental frequencies and due to the balanced nature of this mixer, a high output is produced with a minimum of harmonic or spurious content. A low pass filter removes the fundamental frequencies and allows the output or heterodyne frequencies to pass out through the monitor and attenuator to the final output. The oscillator circuits are similar and have similar frequency versus voltage or frequency versus temperature effects to minimize drifts.

BLANKING CIRCUIT

The purpose of the blanking circuit is to produce a zero base line by removing B+ from the Sweep Oscillator during the sweep retrace. The blanking voltage is originated by a square wave producing circuit. A phased 6.3 volt sinewave is squared and amplified by the blanking tube. This square wave output of V201 controls V304 (EL84), the sweep oscillator voltage regulator tube, and thus deprives the Sweep Oscillator of voltage during one-half of each cycle. PHASE and WIDTH controls are provided for adjusting this blanking voltage to coincide with the horizontal and sweep drive signals.

AUTOMATIC OUTPUT LEVELING CIRCUITRY

A sample of the sweep oscillator output is detected by the monitor diode, located in the monitor block. This detected signal is then amplified and used to control the plate voltage of the sweep oscillator. The RF LEVEL control adjusts the bias on the first stage of the amplifier. This causes the DC levels in the entire amplifier to change, and varies the average B+ supplied to the sweep oscillator from a minimum of 25V to over 100V. A small decrease in the sampling voltage causes a large increase in the B+ supplied to the sweep oscillator, and thus counteracts any amplitude variation as the oscillator is tuned over the range.

The operation of this circuit and of the sweep oscillator can be checked at Pin 1 of V301. The waveform at this point will normally show a flat output level over the entire band. Adjusting the RF LEVEL control will change this level.

To replace the monitor diode, remove the insulated holding screw in the monitor block and then remove diode from the block.

HORIZONTAL SWEEP OUTPUT CIRCUITRY

HI BAND: In order to maintain good linearity, it is necessary to change the shape of the Horizontal Sweep signal for different settings of the SWEEP WIDTH control. This is necessary because of the non-linear characteristics of the vibrating sweep

capacitor. At high sweep width settings a non-linear sawtooth waveform is required for good display linearity. This waveform is produced by V101. A phased 6.3 volt sinewave is applied to the grid of V101A. The tube then clips and amplifies the grid signal so that a square wave is produced at the plate. This square wave is then shaped by a RC network in the plate circuit consisting of R113 and C104 to produce a non-linear sawtooth waveform. R113 (LINEARITY control) is a variable resistor and permits the shape of the waveform to be adjusted. This non-linear sawtooth voltage is then applied to V101B which is connected as a cathode follower. The output of th cathode follower is then applied to the Scope Horizontal Amplifier and compensates for the non-linear characteristics of the vibrating sweep capacitor at high sweep widths. At sweep widths from minimum to approximately 50%, the vibrating sweep capacitor is quite linear. In order to maintain almost perfect linearity for all values of sweep width, a potentiometer is ganged with the sweep width potentiometer which automatically changes the scope horizontal sweep voltage from a sinusoidal waveform at low sweep width settings to a non-linear sawtooth waveform at high sweep width settings.

LOW BAND: In order to maintain good display linearity at high sweep width settings, a linear sawtooth waveform is required. This linear sawtooth voltage is produced by V102. A square wave from the plate of V101A is applied to the grid of V102A. The tube then clips and amplifies the grid signal so that a square wave of opposite polarity appears at the plate. This square wave is then shaped by a RC network in the plate circuit consisting of R120 and C108 to produce a linear sawtooth waveform. This linear sawtooth waveform is then applied to V102B which is connected as a cathode follower. The output of the cathode follower is then applied to the Scope Horizontal Amplifier and compensates for the non-linear characteristics of the vibrating sweep capacitors at high sweep width settings. At sweep widths from minimum to approximately 50%, the vibrating sweep capacitors are quite linear. In order to maintain almost perfect linearity for all values of sweep width, a potentiometer is ganged with the sweep width potentiometer which automatically changes the scope horizontal sweep voltage from a sinusoidal waveform at low sweep width settings to a linear sawtooth waveform at high sweep width settings.

POWER SUPPLY

The power transformer output of 140 volts AC is fed into a half wave voltage doubler, using silicon rectifying elements CR1 and CR2. B+ is taken off the capacity input filter to provide +375 volts unregulated to the plates of V3, (B+ regulator pass tube), V304 (oscillator pass tube), and V4 (marker B+ pass tube).

B+2 is the output of the electronic regulator circuit, consisting of V2 and V3, and provides +175 volts regulated. Potentiometer R1 controls the operating point of V2, regulator amplifier, and is set for proper B+2 output voltage.

B+3 is obtained by biasing the grid of V4 at approximately 85 volts positive, which causes current to flow through cathode resistor R20. The voltage at Pin 3, V4, is supplied to the Plug-In Markers and maintains its regulation due to the low impedance characteristics of the cathode follower circuit and provides approximately 100 volts.

The B- voltage is obtained by the half wave Silicon rectifier CR3. Regulator tube V1 maintains this voltage at -82 volts, and supplies bias voltage to the leveler circuit as well as a reference voltage for the electronic regulator.

Resistor R4 acts as a fuse, protecting the transformer and rectifiers from overload.

The primary of the power transformer is normally wired for 115 volt AC line operation. However, it can be converted to operate from a 230 volt AC source if desired. This conversion is described in the maintenance section.

MARKER SYSTEM DESCRIPTION

GENERAL

A sample of the sweep signal is mixed with the fundamental or a harmonic of the crystal plug-in marker units or external signal to produce beatnotes or birdies. These birdies are then amplified and superimposed upon the demodulated swept signal and applied to the vertical amplifier of the oscilloscope. The size and shape of the marker may be varied over a wide range by the SIZE and SHAPER Control of the birdy amplifier.

EXTERNAL MARKER INPUT

The CW signal from the external marker input is fed into a diode mixer, where it is mixed with a sample of the sweep signal to produce birdies. The resultant birdy is then fed into the birdy-by-pass amplifier.

PLUG-IN MARKERS

This unit has provisions for a maximum of eight single-frequency (C type) crystal markers or four harmonic (CDH type), or any combination. Each CDH type marker occupies the space of two C type.

SINGLE FREQUENCY MARKERS (C TYPE)

These crystal markers are self-contained plug-in units. Additional units at other frequencies (within the range of the sweep generator) may be ordered and substituted for the original units.

The crystal oscillator units include the tube, crystal oscillator tuning, crystal diode mixer, and a tuned circuit selecting the sweep input frequency. A test point is provided for easy adjustment of the overtone crystal oscillator (this circuit used above 12 mc.). In making this adjustment, the crystal oscillator coil slug is adjusted for near maximum voltage at the test point. This is usually in the order of 2-5 volts as measured with a VTVM. The adjustment should be made just slightly off the peak on the low inductance side, since the effects of tuning are critical on the other side of the resonance curve. Crystal oscillators below 12 mc. are Pierce type oscillator circuits which require no tuning.

By tuning the sweep sample coil, the frequency of the sweep input signal can be varied and thus minimize unwanted markers generated from other harmonics of the crystal oscillator. The amplitude can be varied by adjusting the coupling.

HARMONIC MARKERS

The Telonic CDH type marker uses two tubes and occupies two of the plug-in positions on the marker strip.

In this marker unit, harmonics of the signal from a crystal-controlled oscillator are mixed with a portion of the sweep signal to produce a display of markers at regular intervals across the sweep range. Satisfactory markers are produced to over 1000 Mc in most of these units.

See our literature on plug-in markers for additional information.

POWER SUPPLY: Since a defect in the power supply will affect all circuits, it should be checked for proper operation before proceeding to other circuits.

SUPPLY	NOMINAL VALUE	NORMAL VARIATION	NORMAL RIPPLE	WIRE COLOR*
AC Line	115V	----------	------	------
B+1	375	±15 Volts	6 to 15 volts	Red
B+2	175	±.5 Volts	12 to 25 millivolts	Blue
B+3	100	±5-10 Volts	15 millivolts to .5 volts	Orange
B-	-82	±2 Volts	100 millivolts	White
6.3 "A"	6.3V AC	Main filament supply		Green
6.3 "B"	6.3V AC	180° out of phase with supply "A". Source of phasing and filament voltages.		Gray
6.3 "C"	6.3V AC	Isolated filament voltage for tubes with cathodes above ground.		Brown

NEXT: If power supply is operating normal, use the block diagram to isolate the trouble to a major section. Check tubes, diodes, and adjustment of Front Panel and printed wiring board controls located within that section (see Page 7 for adjustment procedure). By the use of the schematic, ordinary difficulties encountered can be readily located and remedied. The following trouble-shooting chart is an additional aid to servicing:

SYMPTOM	POSSIBLE CAUSE AND REMEDIES
Pilot Light Off and Unit Fails to Operate	Fuse open - replace. If second fuse opens - look for cause of overload, shorted wiring, components, etc.
B+1 Off Value or Excessive Ripple	Check R4, C1, C2, CR1, and CR2.
B+2 Off Value or Excessive Ripple	Check R1 for proper adjustment. Check R15, it will burn out if B+2 is overloaded. Check V1, V2, V3, tubes and circuitry.
B+3 Off Value or Excessive Ripple	Check R17 and R21 (these resistors adjust the voltage on the grid of V4, a cathode follower, which in turn determines the voltage on the cathode). Check R18 (this resistor will burn out if B+3 is overloaded). Check V4 and C2.
B- Off Value or Excessive Ripple	Check C3, C4, C5, CR3, R3, R5, and R6. Check V1 to see if it is lit properly (should be a steady orange glow).

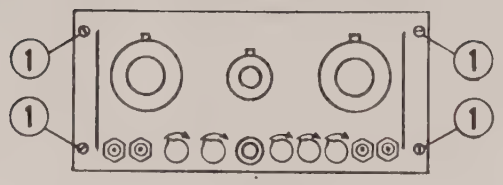
*Wire colors do not apply to shielded wires - single wires only.

V1 Not Lit Properly	If replacing V1 and checking the above parts does not remedy the trouble, check the line voltage. Low line voltage could cause this trouble. Reducing the value of R3 slightly will usually eliminate this difficulty.
RF Output is Low or Zero	Check R314 - this resistor will burn out if the B+ to the Sweep Oscillator is overloaded. Check B+ to the Sweep Oscillator, cathode of V304. It should be a positive square wave of 25-100 volts and should vary as the OUTPUT LEVEL control varies. If it is normal, look for RF difficulties, defective tube, components, shorted or open wiring, etc. Replace mixer diodes in sweeper box, observe polarity. If the voltage is low and does not respond to the LEVEL control, remove first V303 and then V201. When either of these tubes conducts, the voltage on the grid of V304 (pin 2) is reduced and thus decreases the B+ to the Sweep Oscillator. If removal of V201 allows the B+ on V304 (pin 3) to return to normal, check the blanking tube, controls, and associated circuitry. If removal of V303 causes the B+ to return to normal, check the LEVELER controls, V301 and V302, tubes, and associated circuitry.
Poor Leveling	Replace monitor diode. Also replace V301, V302, and V303. V301 is the most critical since it is in the first stage of the DC coupled amplifier. Resetting the printed circuit LEVEL controls is sometimes necessary if these tubes are replaced.
Weak Markers	Replace IN82 or IN34 crystal diode mixer. Check Birdy-By-Pass Amplifier, tubes and circuitry.
No Horizontal Output	Look for difficulty in the sawtooth circuitry V101, using the printed circuit board layout and schematic to check waveforms and voltages.

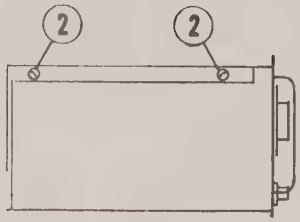
CONVERSION FOR 230 VOLT POWER LINES

The dual primary of the power transformer is normally wired in parallel for use with 115 volt AC lines. The windings can easily be reconnected in series for use with 230 volt power. With the aid of the Chassis Layout, bottom view, locate terminals 1, 2, 3 and 4. Remove the jumper wires from terminals 1 and 2 and terminals 3 and 4. Connect a jumper wire between terminals 2 and 3. Remove the 2 amp fuse (F1) and replace with a 1 amp Slo-Blo fuse.

RACK MOUNTED UNIT



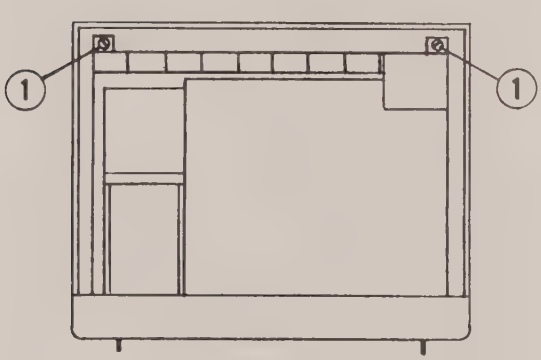
FRONT



SIDE

Unit has front panel slotted or drilled for standard RTMA Mounting. Position unit in rack and install mounting screws in holes marked 1.
Dust cover removal: Remove four #8-32 thread-cutting screws, marked 2 (two on each side) and lift off cover for easy access to chassis.

CABINET MOUNTED UNIT



TOP

FRONT

To remove chassis from cabinet; first remove the two #8-32 screws (marked 1 on top view above) at the back of the chassis (one on each side). These screws fasten the chassis to the cabinet guide rails. Second, remove the four #10-32 screws (marked 2 in front view above). The screws hold the panel to the cabinet.

Slide chassis out of cabinet by pulling forward on the two front panel handles.

To replace chassis in cabinet, insert the flanges on the bottom of the chassis side panels into the slot of the cabinet guide rails. Push chassis back into cabinet far enough for the slots in the side panel flanges to align with the retained nut in guide rail. Install the two #8-32 screws and tighten securely. Replace the four #10-32 screws in the front panel.

PART VALUE INFORMATION

SCHEMATIC PART DESIGNATION	
C	Capacitor
CR	Crystal Rectifier, Germanium Diode
F	Fuse
I	Incandescent Pilot Light
J	Jack or termination, Coaxial Connector
K	Cable
L	Coil
M	Meter or Motor
P	Plug, Coaxial Connector
R	Resistor, Fixed or Variable
S	Switch
T	Transformer
V	Tube
Z	Miscellaneous

SCHEMATIC VALUE ABBREVIATION	
Ω	ohms
K Ω	1,000 ohms
M Ω	1,000,000 ohms (megohms)
µf, uf	Microfarad
pf	Picofarad
µh, uh	Microhenry
mh	Millihenry

RESISTORS - All resistors are 1/2 watt ± 10%, and are shown in ohms, unless otherwise specified.

NOTE: Resistors in the attenuator pads are ± 2%.

CAPACITORS - All Capacitors are shown in picofarads (pf) unless otherwise specified.

COILS - All coils are shown in microhenries (µh) unless otherwise specified.

PARTS LOCATION - F.P. Front Panel
P.C.B. Printed Circuit Board
R.P. Rear Panel
C.H. Chassis
T.P. Test Point

PARTS NUMBERS - LOCATION INFORMATION

1 - 99 - Power Supply
101 - 199 - Horizontal and Alternate Sweep Drive Circuit
201 - 299 - Blanking
301 - 399 - Leveler
401 - 499 - Birdy-By-Pass
501 - 599 - Mixer & Plug-In Markers
601 - 699 - Variable Markers
701 - 799 - Attenuators
801 - 899 - Sweep Oscillator and Sweep Drive Circuit
901 - 999 - Modifications and Special Circuits

*Indicates value of component adjusted at factory, and may deviate from value shown on print.

—O— 16 Indicates printed circuit board terminal.

N O T I C E

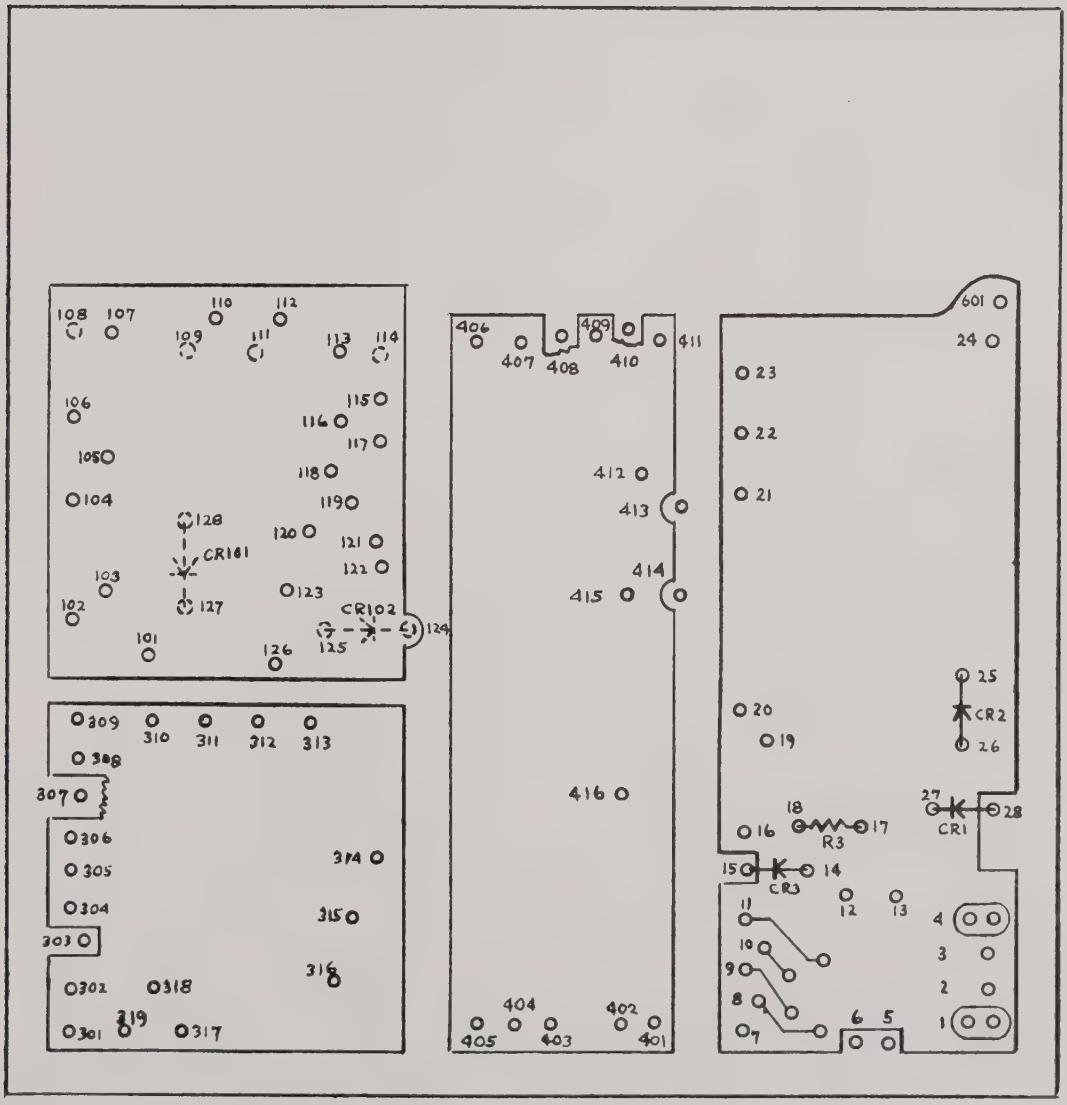
RED LACQUER IS USED TO INDICATE FASTENINGS THAT SHOULD NOT BE DISTURBED FOR ORDINARY SERVICE, AND TO SECURE ADJUSTABLE CONTROLS.

CHASSIS LAYOUT

BOTTOM VIEW

TERMINALS

FRONT



PARTS LIST

CIRCUIT REF.	DESCRIPTION	TELONIC PART NO.
C1	CFE, 80μf, 250VDCW	C-314
C2	CFE, 20/80μf, 250/450VDCW	C-308
C3	CFE, 30μf, 250VDCW	C-313
C4	Same as C3	
C5	CFE, 30μf, 150VDCW	C-312
C6	CFP, 0.22μf, ±20%, 400VDCW	C-217
C7	Same as C6	
C101	CFP, 0.1μf, ±10%, 200VDCW	C-203
C102	Same as C101	
C103	CFM, 3300pf, ±10%, 500VDCW	C-52
C104	CFM, 200pf, ±10%, 500VDCW	C-24
C105	CFP, 0.47μf, 200VDCW	C-223
C106	NA	
C107	NA	
C108	CFP, 0.01μf, ±10%, 600VDCW	C-210
C109	Same as C101	
C110	Same as C101	
C201	Same as C101	
C202	Same as C6	
C301	CFC, 0.01μf, +80-20%, 500VDCW	C-20
C302	CFC, 50pf, ±10%, 1000VDCW	C-11
C303	CFC, 33pf, ±10%, 1000VDCW	C-10
C304	Same as C301	
C401	CFC, 120pf, ±10%, 1000VDCW	C-14
C402	Same as C301	
C403	Same as C301	
C404	Same as C301	
C405	CFC, 1000pf, GMV, 1000VDCW	C-19
C406	Same as C405	
C407	Same as C301	
C408	Same as C301	
C409	Same as C301	
C410	Same as C301	
C411	Same as C301	
C501	CFCF, 1000pf, 1000VDCW	C-39
C801	CFCF, 1000pf, +100-0%, 500VDCW	C-110
C802	Same as C801	
C803	Same as C801	
C804	Same as C801	
C805	Same as C801	
C806	Same as C501	
C807	Same as C501	
C808	Same as C501	
C809	Same as C501	
C810	Same as C501	
C811	Same as C501	
C812	Same as C501	
C813	Same as C501	
C814	CFC, 4pf, ±5%, 500VDCW	C-41
C815	Same as C814	
C816	CFN, 0.43pf, ±10%, 500VDCW	C-58
C817	CFE (SC)	
C818	CFE (SC)	
C819	CFN, 3pf, ±10%, 500VDCW	C-34
C820	Same as C301	
CR1	DS, 1N2094	D-7
CR2	Same as CR1	
CR3	Same as CR1	
CR101	Same as CR1	
CR102	Same as CR1	
CR501	DS, 1N82	D-1
CR801	Same as CR501	
CR802	Same as CR501	
CR803	Same as CR501	
CR804	Same as CR501	
CR805	DS, 1N21B	D-3
F1	Fuse, 3AG, 2a, 250V	MP-6
I1	Lamp, incandescent, #47	MP-5
J101	RJ, 2545-1	J-10
J401	Same as J101	
J402	Same as J101	
J501	TC, MX1684/U	J-9
J502	Same as J501	
J503	RJ, 2559-1	J-11
J504	Same as J501	
J505	Same as J501	
J506	JRTA	J-23
J507	Same as J506	
J701	PO Z701	
J702	PO Z701	
J703	Same as J503	
J801	PO Z803	
J802	PO Z804	
J803	PO S802	
J804	PO S802	
J805	PO S802	
J806	RJ, UG-185/U	J-3
J807	RJ, UG-535/U	J-6
J808	Same as J806	
L401	IV, 6 to 11 mh	L-23
L801	IF, 0.3μh	L-104
L802	IF, 2.2μh, ±10%	L-101
L803	Same as L802	
L804	IF, 2.2μh, ±20%	L-100
L805	IF, 0.6μh	L-29
L806	Same as L801	
L807	Same as L805	
L808	Same as L802	
L809	Same as L802	
L810	Same as L804	
L811	IF	09027
L812	IF	09028
L813	IF	09029
L814	IV	09035
L815	IF, 0.68μh, ±15%	L-103

CIRCUIT REF.	DESCRIPTION	TELONIC PART NO.
P506	PC, UG-88B/U	J-32
P507	Same as P506	
P701	Same as P506	
P702	Same as P506	
P801	Same as P506	
P802	Same as P506	
P803	Same as P506	
P804	Same as P506	
P805	Same as P506	
P806	Same as P506	
P807	Same as P506	
P808	Same as P506	
R1	RVC, 50KΩ, ±30%, 2/10W	R-725
R2	NA	
R3	RFW, 10KΩ, ±5%, 5W	R-404
R4	RFC, 4.7Ω, ±10%, 1W	R-206
R5	RFC, 4.7KΩ, ±10%, 2W	R-306
R6	RFC, 1KΩ, ±10%, 1W	R-208
R7	Same as R4	
R8	RFC, 47KΩ, ±10%, 1/2W	R-27
R9	RFC, 47KΩ, ±10%, 2W	R-305
R10	RFC, 100KΩ, ±10%, 2W	R-303
R11	RFC, 1MΩ, ±10%, 1/2W	R-31
R12	RFC, 22Ω, ±10%, 1/2W	R-11
R13	RFC, 27KΩ, ±10%, 2W	R-304
R14	RFC, 180KΩ, ±10%, 1/2W	R-45
R15	RFC, 100Ω, ±10%, 1/2W	R-15
R16	Same as R15	
R17	RFC, 220KΩ, ±10%, 1/2W	R-44
R18	Same as R15	
R19	Same as R15	
R20	Same as R17	
R21	Same as R17	
R22	Same as R17	
R23	Same as R17	
R101	RVW, 25Ω, ±10%, 2W	R-713
R102	Same as R101	
R103	Same as R101	
R104	RVC, 100KΩ, ±30%, 2/10W	R-732
R105	RVC, 200KΩ, ±30%, 2/10W	R-724
R106	Same as R105	
R107	PO R801	
R108	RFW, 7.5Ω, ±10%, 5W	R-403
R109	Same as R108	
R110	RFC, 560KΩ, ±10%, 1/2W	R-29
R111	Same as R11	
R112	RFC, 10MΩ, ±10%, 1/2W	R-47
R113	RVC, 2MΩ, ±30%, 2/10W	R-729
R114	RFC, 390KΩ, ±10%, 1/2W	R-72
R115	Same as R110	
R116	RFC, 10KΩ, ±10%, 1/2W	R-23
R117	Same as R116	
R118	Same as R112	
R119	RFC, 680KΩ, ±10%, 1/2W	R-30
R120	RFC, 3.3MΩ, ±10%, 1/2W	R-49
R121	NA	
R122	RFC, 5.6KΩ, ±10%, 1/2W	R-22
R123	Same as R17	
R124	Same as R114	
R125	RFC, 33Ω, ±10%, 1/2W	R-12
R126	Same as R15	
R127	RFC, 27KΩ, ±10%, 1/2W	R-25
R201	RVC, 500KΩ, ±30%, 2/10W	R-734
R202	RVC, 1MΩ, ±30%, 2/10W	R-728
R203	Same as R110	
R204	Same as R110	
R205	Same as R110	
R206	Same as R110	
R207	RFC, 39KΩ, ±10%, 1/2W	R-26
R301	RVC, 200KΩ, ±30%, 1/4W	R-707
R302	Same as R1	
R303	Same as R1	
R304	Same as R1	
R305	Same as R1	
R306	Same as R116	
R307	Same as R11	
R308	Same as R110	
R309	Same as R116	
R310	Same as R207	
R311	RFC, 100KΩ, ±10%, 1/2W	R-28
R312	Same as R116	
R313	Same as R11	
R314	Same as R15	
R315	Same as R15	
R316	Same as R15	
R317	Same as R8	
R318	RFC, 330KΩ, ±10%, 1/2W	R-94
R401	Same as R8	
R402	Same as R311	
R403	RFC, 4.7KΩ, ±10%, 1/2W	R-21
R404	Same as R8	
R405	RFC, 22KΩ, ±10%, 1/2W	R-24
R406	Same as R116	
R407	Same as R116	
R408	RVC, 100KΩ, ±30%, 1/3W	R-705
R409	Same as R311	
R410	Same as R403	
R411	Same as R408	
R412	Same as R210	
R413	Same as R15	
R414	Same as R15	
R415	RFC, 1KΩ, ±10%, 1/2W	R-18
R416	NA	
R417	Same as R415	
R418	Same as R15	
R419	Same as R15	
R420	Same as R415	
R421	Same as R415	
R422	Same as R403	
R423	Same as R408	
R424	Same as R311	
R425	Same as R122	
R426	NA	
R427	Same as R116	

CIRCUIT REF.	DESCRIPTION	TELONIC PART NO.
R501	RFC, 220Ω, ±10%, 1/2W	R-39
R502	RFC, 470Ω, ±10%, 1/2W	R-42
R503	RFC, 56Ω, ±5%, 1/2W	R-53
R504	Same as R503	
R505	RFC, 120Ω, ±10%, 1/2W	R-16
R506	Same as R505	
R507	PO J506	
R508	PO J507	
R801	RVW/W/C, 6Ω/6Ω/100KΩ, 2W/2W/1/3W	R-735A
R802	NA	
R803	Same as R505	
R804	Same as R501	
R805	RFC, 180Ω, ±10%, 1/2W	R-52
R806	Same as R403	
R807	Same as R505	
R808	Same as R403	
R809	Same as R505	
R810	RFC, 330Ω, ±10%, 1/2W	R-17
R811	RFC, 300Ω, ±5%, 1/2W	R-77
R812	Same as R811	
R813	RFC, 18Ω, ±10%, 1/2W	R-78
R814	RFC, 56Ω, ±10%, 1/2W (NS)	R-13
R815	RFC, 2.2MΩ, ±10%, 1/2W (NS)	R-34
R816	Same as R505	
S1	SWT, SPST	SW-10
S501-S508	Same as S1	
S801	PO S802	
S802	ASW	31001
T1	TP	T-9A
V1	TE, 5651	VT-17
V2	TE, 6AU6	VT-5
V3	TE, EL84/6BQ5	VT-16
V4	Same as V3	
V101	TE, 12AX7	VT-13
V102	Same as V101	
V201	Same as V101	
V301	Same as V2 (SC)	
V302	Same as V101	
V303	Same as V2	
V304	Same as V3	
V401	Same as V101	
V402	Same as V101	
V403	Same as V101	
V404	Same as V101	
V801	TE, 6AF4 or 6DZ4	VT-4 or VT-51
V802	Same as V801	
Z501-Z508	Socket, wafer	S-11
Z701	Attenuator, RF	05005
Z801	Drive Motor	09021
Z802	Drive Motor	09022
Z803	Filter, low pass	06010
Z804	Filter, low pass	06009
	Post, fuse	S-27
	Nib, tuning	SM-2
	Clip, diode	S-19
	Socket, diode (5 required)	S-9
	Socket, 7-pin (2 required)	S-7
	Socket, 7-pin (4 required)	S-4
	Socket, 9-pin (11 required)	S-5
	Pilot Light Assembly	MP-3

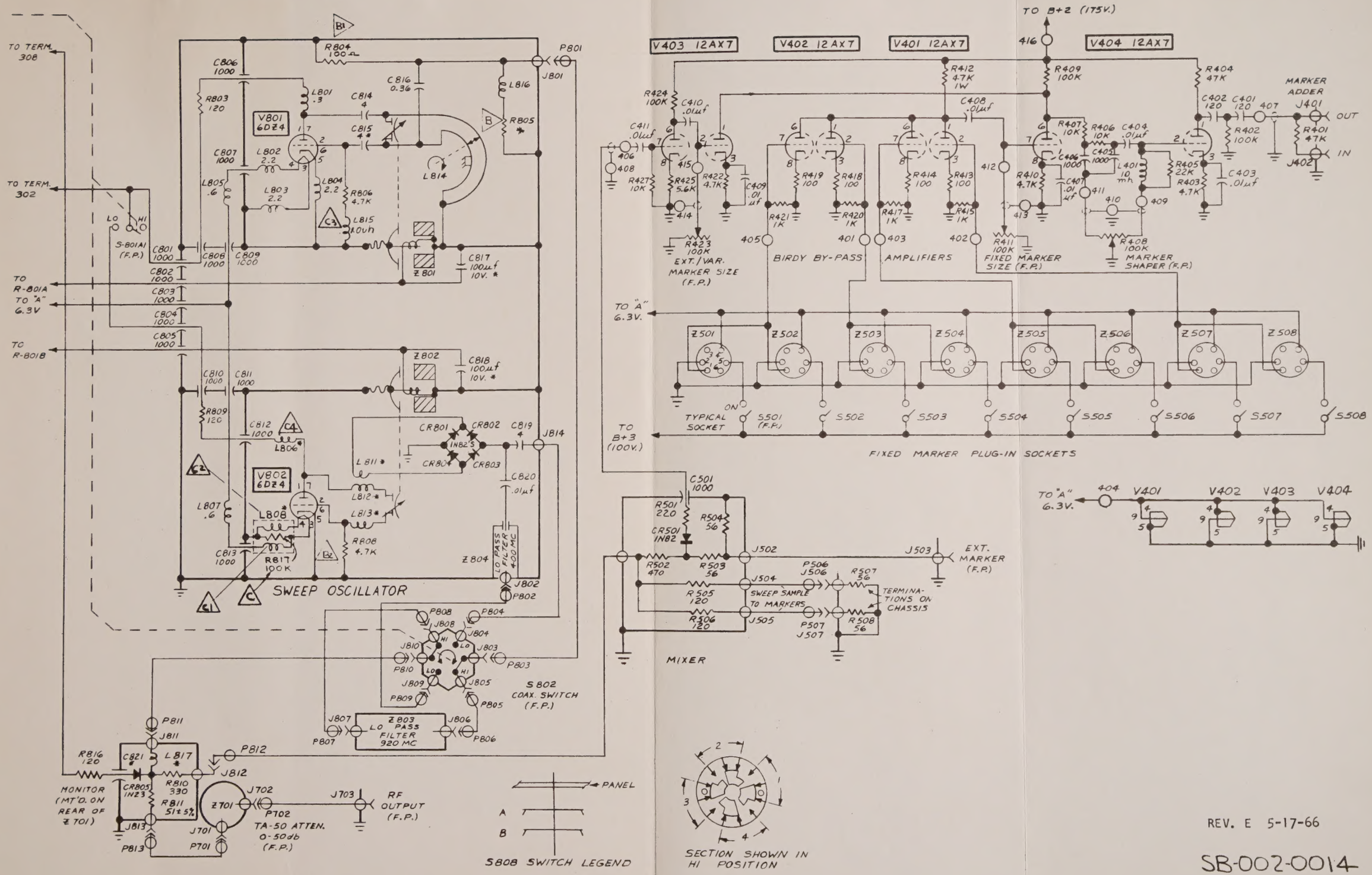
ABBREVIATION CODE

ASW	Assemuty, Switch
CFC	Capacitor, fixed, ceramic
CFCF	Capacitor, fixed, ceramic feed-thru
CFE	Capacitor, fixed, electrolytic
CFM	Capacitor, fixed, mica
CFN	Capacitor, fixed, composition
CFP	Capacitor, fixed, paper
DS	Diode, semiconductor
IF	Inductor, fixed
IV	Inductor, variable
JRTA	Jack resistive terminating assembly
NA	Not assigned
NS	Not on schematic
PC	Plug, cable
PO	Part of
RFC	Resistor, fixed, composition
RFW	Resistor, fixed, wirewound
RJ	Receptacle, Jack
RVC	Resistor, variable, composition
RVW	Resistor, variable, wirewound
RVW/W/C	Resistor, variable wirewound, wirewound, composition
SC	Subject to change
SWT	Switch, Toggle
TC	Terminator, cable
TE	Tube, electron
TP	Transformer, power

MODIFICATION TO HD-1A PARTS LIST

The following parts have been changed, added to or deleted from the HD-1A parts list on the opposite page:

CIRCUIT REFERENCE	DESCRIPTION	TELONIC PART NO.
C816	CFN, 0.36pf, ±10%, 500VDCW	C-30
J801	RJ, UG-185/U	J-3
J802	PO Z804	NA
J803	PO S802	NA
J804	PO S802	NA
J805	PO S802	NA
J806	PO Z803	NA
J807	PO Z803	NA
J808	PO S802	NA
J809	PO S802	NA
J810	PO S802	NA
J811	Same as J801	
J812	RJ, UG-535/U	J-6
J813	Same as J801	
J814	TC, MX-1684/U	J-9
P801-P813	PC, UG-88B/U	J-32
L816	IF	NA
L817	IF, (SC)	NA
R805	RFC, 10MΩ, ±10%, 1/2 W	R-47
R807	Omitted	
R811	RFC, 51Ω, ±5%, 1/2 W	R-3
R812	Omitted	
R813	Omitted	
S802	ASW	31020
Z803	Filter, low-pass	06055


TO TERM. 308
TO TERM. 302
LO
HI
S-801A1 (F.P.)
TO R-801A
TO "A" 6.3V
TO R-801B
B1
R804 100Ω
P801
J801
C806 1000
R803 120
L801 .3
C814 4
C816 0.36
L816
R805 *
V801 6DZ4
C807 1000
L802 2.2
C815 4*
L814
L805 .6
L803 2.2
L804 2.2
R806 4.7K
C3
L815 1.0uh
C801 1000
C806 1000
C809 1000
C802 1000
C803 1000
C804 1000
C805 1000
Z801
C817 100µf 10V. *
Z802
C818 100µf 10V. *
C810 1000
C811 1000
R809 120
C812 1000
C4
L806*
C2
V802 6DZ4
L807 .6
L808*
L812*
L813*
R808 4.7K
C813 1000
R817 100K
B2
C1
C
SWEEP OSCILLATOR
CR801
CR802
IN82'S
CR804
CR803
C819 4
JB14
L811*
C820 .01µf
Z804
LO PASS FILTER 400 MC
J802
P802
P808
P804
JB08
J804
J810
HI
LO
J803
P810
P803
J809
J805
P809
P805
S802 COAX. SWITCH (F.P.)
J807
Z803 LO PASS FILTER 920 MC
J806
P807
P806
P811
J811
P812
R816 120
C821 *
L817 *
J812
MONITOR (MT'D. ON REAR OF Z701)
CR805 IN23
R810 330
R811 51Ω 5%
Z701
J702
P702
TA-50 ATTEN. 0-50db (F.P.)
J703
RF OUTPUT (F.P.)
J813
P813
J701
P701
PANEL
A
B
S808 SWITCH LEGEND
TO B+2 (175V.)
416
V403 12AX7
V402 12AX7
V401 12AX7
V404 12AX7
R412 4.7K 1W
R409 100K
R404 47K
MARKER ADDER
J401
OUT
IN
J402
R401 47K
C402 120
C401 120
407
R402 100K
R424 100K
C410 .01µf
C408 .01µf
C411 .01µf
406
408
R427 10K
R425 5.6K
415
R422 4.7K
C409 .01 µf
414
R423 100K
EXT./VAR. MARKER SIZE (F.P.)
R421 1K
R419 100
R420 1K
R418 100
405
401
BIRDY BY-PASS
R417 1K
R414 100
R415 1K
R413 100
403
402
AMPLIFIERS
412
R411 100K
FIXED MARKER SIZE (F.P.)
413
R410 4.7K
C407 .01 µf
411
C406 1000
C405 1000
L401 10 mh
410
409
R408 100K
MARKER SHAPER (F.P.)
R407 10K
R406 10K
C404 .01µf
R405 22K
R403 4.7K
C403 .01µf
TO "A" 6.3V.
TO B+3 (100V.)
Z501
Z502
Z503
Z504
Z505
Z506
Z507
Z508
ON
TYPICAL SOCKET
S501 (F.P.)
S502
S503
S504
S505
S506
S507
S508
FIXED MARKER PLUG-IN SOCKETS
C501 1000
R501 220
R504 56
CR501 IN82
R502 470
R503 56
J502
J503
EXT. MARKER (F.P.)
P506 J506
R507 56
J504
R505 120
SWEEP SAMPLE TO MARKERS
TERMINATIONS ON CHASSIS
R506 120
J505
P507 J507
R508 56
MIXER
TO "A" 6.3V.
404
V401
V402
V403
V404
SECTION SHOWN IN HI POSITION
REV. E 5-17-66
SB-002-0014

ADDENDUM SHEET

MODEL HD-1A SWEEP GENERATOR INSTRUCTION MANUAL

The following should be considered a part of this manual.

Page 19 Parts List:

Circuit Reference F1:
Under Description - change from: Fuse, 3AG, 2a, 250V
to read: Fuse, 3AG, 2A (115VAC only)
Fuse, Slo-blo, 1A (230VAC only)
Under Telonic Part No. - change from: MP-6
to read: MP-6
MP-45

Circuit Reference R3:
Under Description - change from: RFW, 10KΩ, ±5%, 5W
to read: RFW, 6 KΩ, ±5%, 5W
Under Telonic Part No. - change from: R404
to read: R-401

Circuit Reference R313:
Under Description - change from: Same as R11
to read: RFC, 2.2MΩ, ±10%, 1/2W
Under Telonic Part No. - Add: R-34

Circuit Reference L815:
Under Description - change from: IF, 0.68μh, ±15%
to read: IF, 1μh
Under Telonic Part No. - change from L-103
to read: L-102

Page 19, Parts List:
Delete Circuit Reference L810 in its entirety

Circuit Reference R804:
Under Description - change from: Same as R501
to read: RFC, 100Ω, ±10%, 1/2W
Under Telonic Part No. - Add: R-15

Circuit Reference R805:
Under Description - change from: RFC, 180Ω, ±10%, 1/2W
to read: SC
Under Telonic Part No. - Delete: R-52

ACCO